THE AUDIO LEAGUE REPORT

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FM TUNER IMPROVEMENTS

Last fall two new FM tuners were introduced to the hi-fi public which differed radically from anything that had been offered previously. Strangely, each was the first offering of its manufacturer in the hi-fi FM tuner market. We refer to the H. H. Scott 310 and the National "Criterion" tuners.

Both tuners are basically very similar in design philosophy, 'though it would be hard to find two more dissimilar looking units. A little background on FM receiver circuitry will help to point up the similarities between these tuners and their essential difference from all others.

The most common FM tuner circuit is the one usually referred to as the "Armstrong" circuit, since it conforms in its essentials to the circuit originally developed by Major E. H. Armstrong, the inventor of FM broadcasting as we know it. It usually employs an RF amplifier stage, converter and oscillator, three IF stages (sometimes two) and two saturation limiters, followed by a Foster-Seely discriminator. Most quality tuners employ this circuit, with minor variations.

The performance of an FM tuner with respect to quieting and distortion is largely centered in its limiter and discriminator circuits. The limiter's function is to remove any residual amplitude modulation from the signal such as may be introduced by inadequate IF bandwidth and to prevent any noise such as automobile ignition interference from reaching the discriminator. Without going into technical details, a saturation limiter is not fully effective in suppressing sharp impulse noise, and some form of dynamic, or instantaneous limiting must be used for full noise suppression. There are tubes and circuits available for dynamic limiting which have not seen general use. It is also necessary for the limiter and discriminator bandwidth to be considerably greater than the IF bandwidth for best limiting action and good capture ratio (the ability of the receiver to reject a slightly weaker interfering signal on the same frequency as the desired signal).

The Foster-Seely discriminator is the most common FM detector, used to convert a frequency variation into a voltage corresponding to the signal voltage modulating the transmitter. Unfortunately, it is amplitude sensitive as well; thus the need for limiters, if a high signal/noise ratio is to be obtained.

The ratio detector is another popular FM detector. It is basically insensitive to AM, and is frequently used in cheap FM receivers to save the expense of limiter stages. This association with cheap, inadequate receivers has placed an unwarranted stigma on the ratio detector, which is inherently as good as any other, plus being insensitive to AM.

There are other FM detectors which are rarely used, one of which is the so-called "counter" type employed by National. It is different from either the Foster-Seely discriminator or the ratio detector, and is inherently linear over a very wide bandwidth.

The IF band pass characteristics of most FM tuners are a far cry from the ideal flat-topped response. Usually they come to a definite peak, and fall off gradually as shown in Fig. 1a, with a bandwidth (we hope) of at least 150 kc at the 6 db down points. The sloping sides introduce AM on an FM signal, which may reach rather large percentages and must be removed by the limiters. It is also necessary to tune the carrier exactly on the peak of the response curve for maximum quieting. A small amount of drift in the receiver's oscillator can put the carrier down on the sides of the response curve, with resultant background noise and/or distortion. It is also possible, because of the nature of the discriminator response, to tune in the signal at 3 points closely spaced on the dial, the center response being the correct one. This awkward tuning characteristic, plus excessive drift in many commercial sets, gave FM a bad name with a large segment of the general public in the early post-war years. The ratio detector does not have as pronounced a tendency to give triple responses, so sets using it are somewhat easier to tune.

The solution to the tuning problem, in most cases, has been the use of AFC (Automatic Frequency Control) plus more stable oscillators. With AFC, the station snaps in with a "plop" as it is approached and is held in tune over a considerable range of tuning dial adjustment (or oscillator drift). A definite "rubbery" feel is imparted to tuning when a strong AFC action is used. Its main disadvantage is that it is difficult to tune in a weak station near the frequency of a strong one,

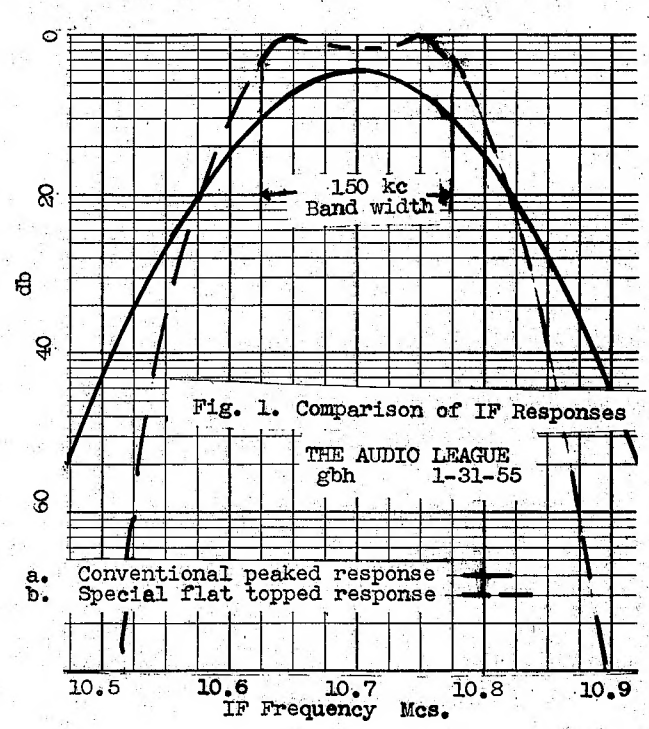

Fig. 1. Comparison of IF Responses

INDUSTRY NOTES

CRAFTSMEN announces substantial price reductions resulting from direct factory sales replacing distributorships.

LANGÉVIN has decided not to market the unuaual preamplifier and accompanying power amplifier which they exhibited at the NY Audio Fair. Too bad-- it promised to be one of the top values in the field.

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PILOTONE AA-903 AMPLIFIER

Last spring Consumers Union published the results of their extensive testing of hi-fi amplifiers. Some of their conclusions were startling, to say the least. In particular, they rated the Pilotone AA-903 ($69.50) as the best buy, and second in overall quality only to the Bogen DB-20 ($99.50). Following the Pilotone AA-903 in overall quality, according to CU, was the Fisher 50A, with all the other thirty or so amplifiers trailing behind.

We're not going to make a report here on CU's report - except to say that we disagree violently with the conclusions they reached from their own data (we do not question the accuracy of their measurements). We did feel that if the AA-903 was a fraction as good as CU's report made it out to be, it could be an excellent buy indeed. Therefore, we obtained one and gave it the Audio League tests as applied to power amplifiers and preamplifiers.

Pilot's advertised specifications are:

Sensitivity for 1 volt output, 10 mv. on phono, 150 mv. on radio and aux. inputs.

Hum Level: Variously claimed to be 70 db or 80 db below 1 volt (where?) or below maximum output.

Power Output: 10 watts maximum

Total Harmonic Distortion: Less than 1% at 10 watts from 30 - 15000 cps
0.1% at 1 watt from 30-15000 cps

Negative feedback: 15 db

Output Impedance: 4, 8, 16 ohms

Damping factor: 8

Power consumption: 75 watts, 117v. 60 cps

Overall dimensions: 12"w.x 8-3/4"D x 7"H

Shipping Weight: 15 lbs.

Phono equalization for LP, AES, NAB, FOREIGN

Input impedance: Radio and Aux. 500,000 ohm
Phono - adjustable from 6800 to 100,000 ohms

Frequency Response: ± 1 db 15-40000 cps at 10 watts

IM Distortion: less than 2% at 10 watts output
(50 and 7000 cps, 4:1)

Fairly detailed specifications are also given for tone control range. The tube lineup employs 12AX7 phono pre-amp 12AX7 tone control amplifier, 6C4 voltage amplifier, 12AU7 phase inverter, and push-pull 6V6GT output stage (tetrode connected).

Other convenient features include a detachable front panel plate for custome installations using up to a 3/8" wood panel: Bass and treble tone controls with flat settings at the center settings of the knobs (they are quite flat too - see Fig.4); a convenience outlet controlled by the ON-OFF switch; and an attractive gold finish impervious to fingerprints (it was, too).

The circuit is advertised as "Williamson type". See Vol. 1, No. 1 of the REPORT for our comments on this. It is not a true Williamson, of course - neither insofar as circuitry or performance is concerned.

The gain of the AA-903 is substantially higher than claimed, with 1.35 mv on Phono and 100 mv on Radio input being required for 1 volt output at the 8 ohm tap.

We measured hum and noise level at 64 db below 10 watts output on Aux and Radio inputs (input open) and -50 db on Phono (15K input resistance) with maximum gain. At minimum gain the hum was 71 db below 10 watts on all channels. This doesn't agree too well with Pilot's claims, unless they obtained their -70 db figure at minimum gain. At any rate, the hum is quite inaudible under home listening conditions, unless you deliberately look for it.

We measured the maximum sine wave power output before clipping at 9.7 watts (mid-frequencies). All OK on that score.

The frequency and power response are shown in Fig. 2. Except for the 2.5 db rise at 12 cycles, the response is flat within 1 db up to 100 kc, with the test signal injected after the tone controls. The power response of the AA-903 is down 3 db at 14 cycles and 37 kc. This is adequate for ordinary listening levels in the home, but is not recommended for anyone who likes to loosen the window panes with 32 ft. organ pipes or bass drums since there are only about 5 or 6 watts available in the 16 cycle region. If Pilot had broadened their tolerances on their frequency response claims from ±1 db to ±3 db, they would have been right on the nose.

Fig. 2. FREQUENCY RESPONSE PILOTONE AA-903 AMPLIFIER

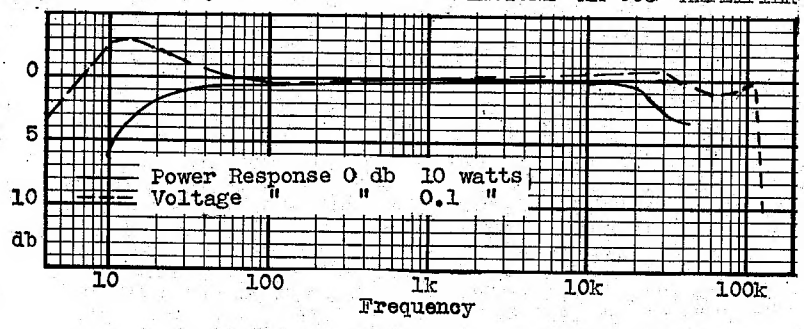

Fig. 3 shows the intermodulation distortion of the AA-903 as a function of power. It bears out with unusual exactness the advertised figure of 2% I.M. at 10 watts.

The tone control characteristics are plotted in Fig. 4. The range of control is quite large, especially in the bass; applying full bass and treble boost, curiously, reduces the mid-

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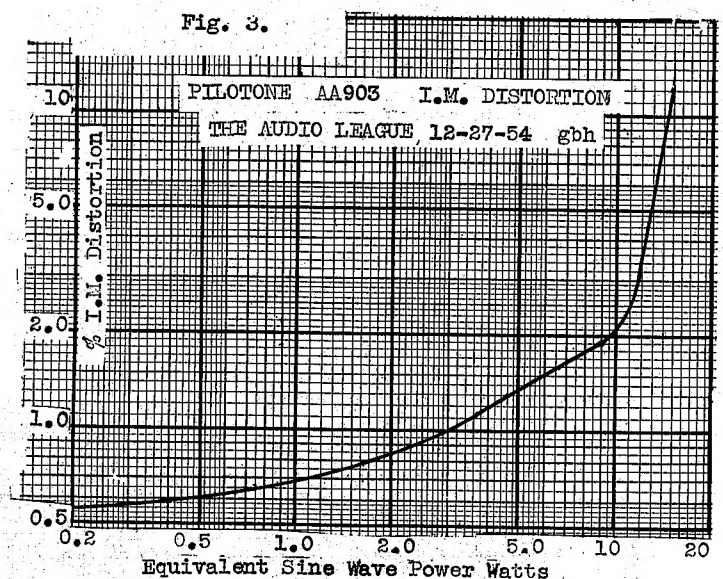
Fig. 3.



range response by some 4 db. The center positions of the tone controls yield a reasonably flat curve, ±1 db 20-10000 cycles, falling off to -4db at 20000 cycles. Probably a little treble boost could have improved the overall flatness on the high end.

We checked the accuracy of the phono equalization, using the NAB position for equalizing the RIAA curve. Fig. 5 shows the error in phono equalization on the various switch positions. The AES curve is quite well equalized - ±3 db from 20-18000 cycles. The LP curve has fairly sizeable errors, while the RIAA curve is almost perfectly equalized in the NAB position above 60 cycles. Below that point the bass is boosted, being up 8 db at 20 cycles. Most speaker systems, especially those which might be used in conjunction with an amplifier in this price class, can well stand a few db of boost at the extreme bottom, 'though this will accentuate any rumble introduced in the playback process- by 6 db at the predominant 30 cycle rumble frequency associated with four-pole phono motors. The EUR position is designed for certain foreign records with little recorded pre-emphasis. Its low end is identical to AES, while the highs are only rolled off 4 or 5 db at 10000 cycles.

The AA-903 offers one feature found in few other amplifiers - a continuously adjustable phono cartridge termination, calibrated from 6.8K to 100K. By means of this, any magnetic cartridge may be properly terminated without soldering or clipping out parts, as is sometimes done.

Where, then, should the Pilotone AA-903 fit in the family tree of hi-fi amplifiers? Without having tested competitive amplifiers in its price range it may seem a little unfair to call the AA-903 a "Best Buy". However, we found so many evidences of good design and construction combined with above-average flexibility and a very modest price, that we'll agree with CU- it is a "Best Buy", as far as we are concerned,

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Fig. 5.

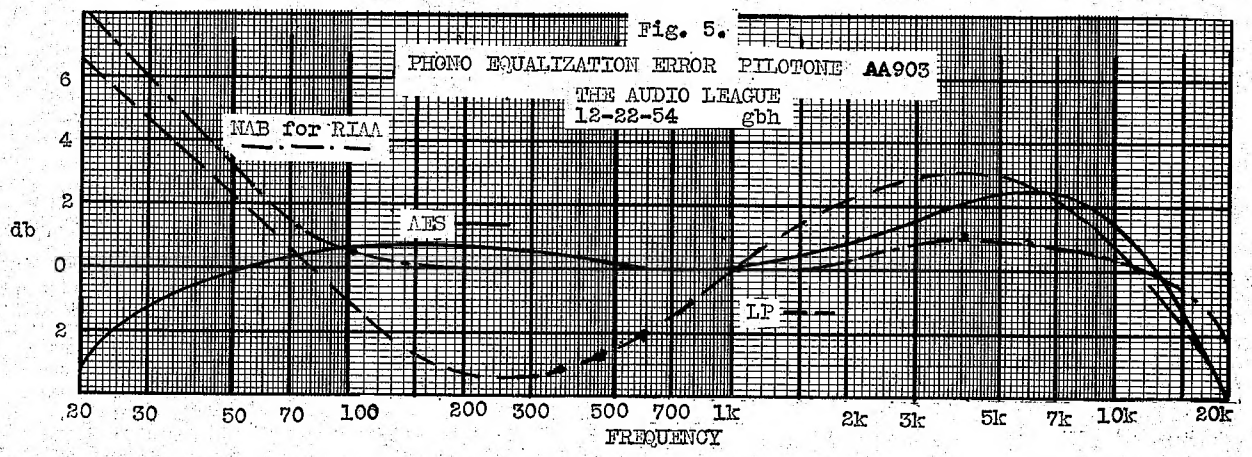
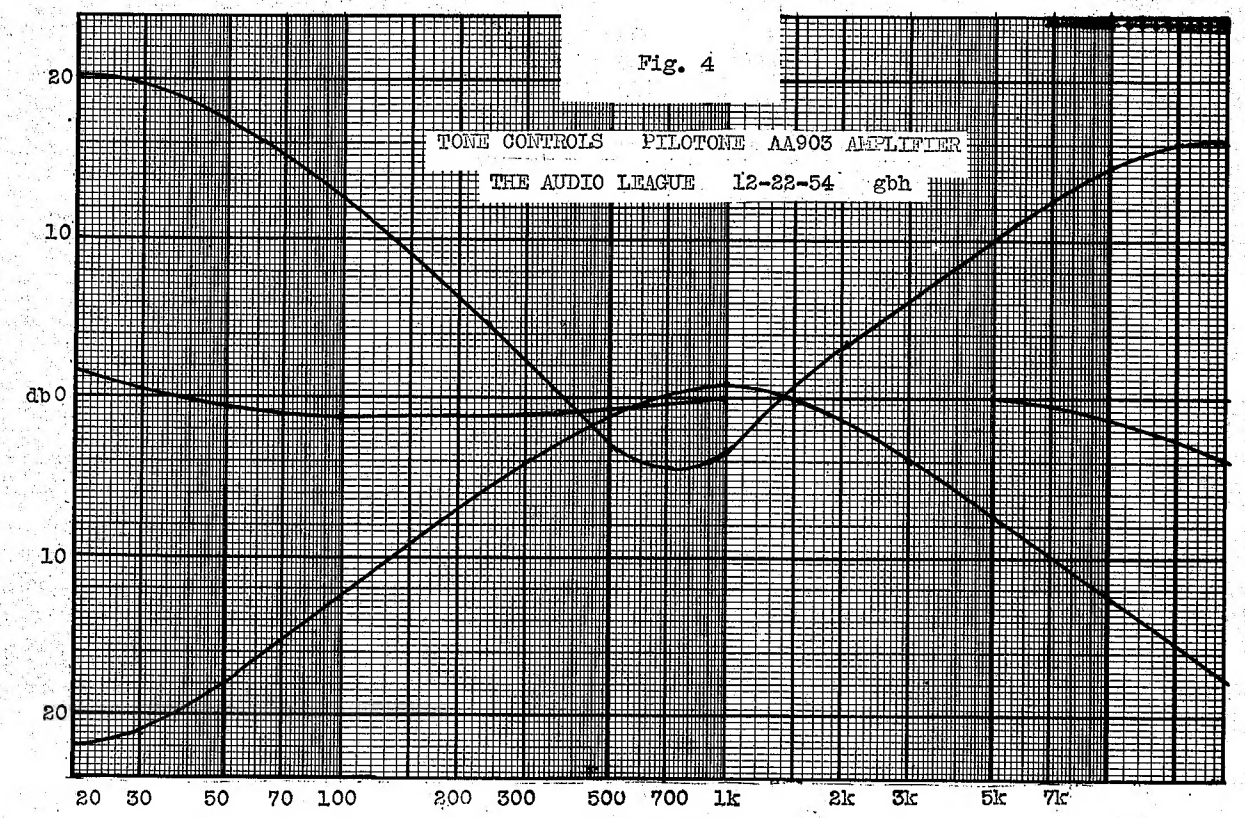


Fig. 4



SCOTT 310 FM TUNER

Scott has departed radically from conventional physical packaging in his offering. It is in a flat, table-top form, similar to the many compact or integrated amplifiers on the market. It is 4½"H x 13"W x 10¼"L ; the panel is brass finished, with a unique dial scale. For one thing, the dial pointer is a piece of lucite which slides along the lower edge of the panel and carries illumination from a concealed pilot light to the portion of the dial at which it points. It is connected to the tuning capacitor via what appears to be a stainless steel flexible cable, and the pointer itself serves as a coarse tuning knob - just slide it from one end of the dial to the other by a flick of the finger. Thanks to the broad band IF system, tuning is sufficiently non-critical to actually permit the coarse tuning lever alone to be used if it is so desired. A knob marked "fine tuning" is used to move the tuning mechanism and pointer at a less precipitate pace and with more precision, of course.

Another feature of the dial scale, almost unique if not entirely so, is the fact that it is almost linear with frequency, and marked every megacycle. We found no difficulty in pre-setting it to any frequency desired (±100 kc or so) with the volume off, turning up the volume and finding the desired station accurately tuned in. This feature is in marked contrast with the National, as we will point out later.

One slightly annoying feature is that the electrical return path for the pilot light bulb is through the carriage that mounts the lucite pointer, which rolls on rails. As it is tuned, it makes an intermittent contact which causes the light to flicker on and off. There is no audible effect from this, but it looks a bit peculiar.

The Scott tube lineup features a 6BK7A cascode RF stage, 6U8 converter and oscillator, 3-6AU6 IF stages, a 6BN6 dynamic limiter, a 6AU6 saturation limiter, a pair of crystal diodes in the ratio detector (which acts as a third stage of limiting), 2-12AU7's in the audio and squelch circuits, and a 6X5 rectifier. A third crystal diode acts as AGC rectifier.

It has an effective AGC (Automatic Gain Congrol) circuit, which acts on the RF stage. This is important if the IF response curve is to be independent of signal strength. It also serves to actuate a tuning meter which reads the plate current of the RF stage. Tuning is very easy with this, although it is actually not necessary. It serves to indicate signal strength, so would be handy when an antenna rotator is used to indicate when it is aimed for maximum signal. It also dramatically demonstrates the flat top and steep sides of the IF response. As the tuning knob is turned, the meter suddenly rises, reads a constant value for a perceptible amount of tuning knob movement (apparently 150 kc, judging from dial calibration) and just as suddenly falls to its background noise level.

Obviously much effort has been made in the design of this IF amplifier to obtain near theoretically perfect results, expecially as regards the shape of the bandpass characteristic. Conventional IF transformers available to home constructors and most manufacturers do not ordinarily have the flat top and steep skirts that this receiver displays. We suspect that even though their external appearance is similar to ordinary IF transformers, the internal construction of Scott's units may be unusual (higher Q, etc.).

There is a squelch control on the front panel, labeled "DYNAURAL". Needless to say, this has no relation to Scott's "Dynaural" noise suppressor other than being a signal actuated device, which we suppose to be the intent of the name. This is actuated by the AGC voltage and acts to cut off an audio amplifier stage, when AGC voltage falls below a pre-determined level. It can be set to operate at any level, or not at all. In practice, the knob is turned until the background hiss between stations just disappears. Then any signal stronger than the noise will "pop" out of silent background. It can also be adjusted to reject any signal below an arbitrary level, up to about a hundred microvolts. In this case only strong local signals would be heard as the band is swept. Our only criticism of its operation is that as one approaches a station, there is a burst of noise and "monkey chatter" just before the station appears. This can be quite loud and annoying, especially if the volume control is well advanced. The tuning meter is operative at all times, so it will show the presence of a signal which may be too weak to overcome the squelch. Incidentally, getting a little ahead of ourselves, we found that any signal which could move the meter could also be heard with excellent quieting.

We checked drift from a cold start by pre-setting the dial to the indicated frequency of a local station, turning the set on, and forgetting about it. After 15 seconds or so, the station appeared, apparently tuned "on the nose" and remained that way for 8 hours of continous operation. This is quite a stunt, particularly when one depends solely on dial calibration to pick the right station out of a cluster of 4 or 5 strong stations spaced only one channel apart in some cases. Conclusion: The Scott 310 indeed has negligible drift plus a remarkably accurate and readable dial scale.

In home listening tests, the Scott accomplished something which no other set had been able to do up to that time (the National did the same later). We have two stations separated by 400 kc, one a local with a transmitter less than two miles from our home, the other some 25 miles away and much weaker. On any other set we had used, "monkey chatter" from the stronger station was present to a greater or lesser degree on the weaker one, and tuning from one to the other was continuous in any set with AFC (no dead space between them. The Scott not only separated them fully - there was a dead space between them and of course no trace of "monkey chatter". Steep IF skirt selectivity!

As for measured performance, the curves in Fig. 6 speak for themselves. Note that the quieting curve is for noise quieting, not signal-to-noise ratio. See the discussion of measurement of quieting sensitivity on page 7. Approximately 5 microvolts of input ("hard" microvolts) gave 20 db of noise quieting. The increase in signal was about 11 db over the background noise with no signal, so the sensitivity of the receiver was 3.3 microvolts for a 20 db signal/noise ratio, (sometimes called "quieting sensitivity - erroneously, in our opinion). Scott's claims are 2 microvolts for 20 db quieting, and 4 microvolts for 40 db quieting. If they are using "soft" microvolts (see Vol. 1, No. 3, The Audio League Report, page 5), their claims are fulfilled or exceeded by measured performance; if they are using "hard" microvolts, they are still mighty close. The 310 is the most sensitive tuner we have yet tested, though the Fisher 70RT is almost as good.

After 8 hours of operation, the chassis was only slightly warm to the touch and the power transformer was cool enough to permit resting the hand indefinitely. We would judge that the power transformer is the most conservatively rated unit we have encountered in any commercial receiver.

We have a few very minor suggestions for improvements, none of which affect the receiver's performance:

(1) Do something to eliminate that blinking dial light;
(2) A light for the tuning meter would be a handy thing, adding to appearance and utility at low cost;
(3) The audio output is presently through a permanently affixed 7-foot shielded cable with a standard male phono plug at its end. While this undoubtedly is very handy for most users, what about the occasional one who needs more than 7 feet (Scott says up to 70 feet is OK) or whose amplifier or preamplifer has another type of input connector? We would suggest using a male plug at each end of the cable, with a female phono connector on the chassis. In this way no clipping of the present cable would be required if a longer lead is called for.

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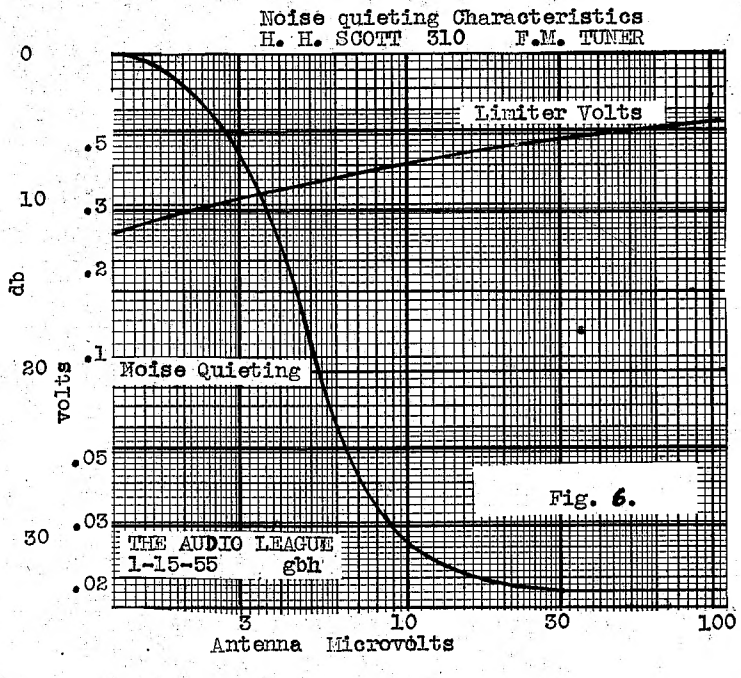


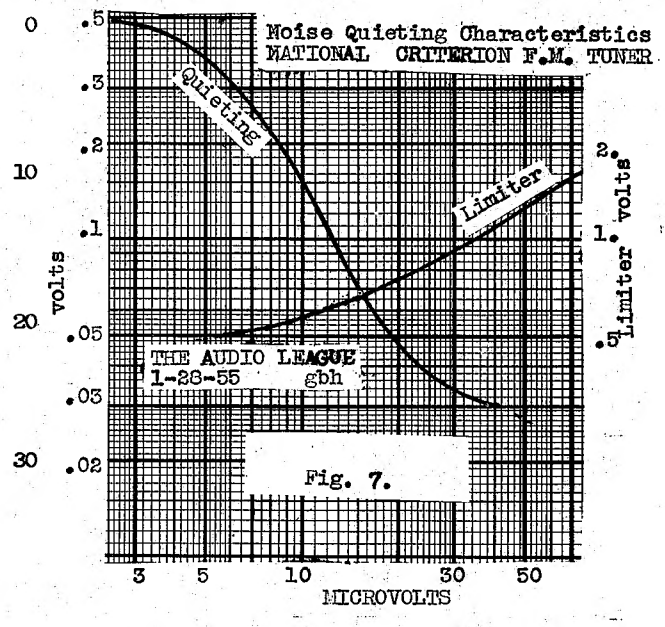
NATIONAL "CRITERION" FM-AM BINAURAL TUNER

Last fall, when we first saw the new Criterion at the New York Audio Fair, we were very impressed with its sensitivity and general performance and so commented in our November issue. We were unable to obtain one for test from our usual sources due to short supply, and a letter to National asking for the loan of a set brought no response - perhaps the letter went astray. In any event, we finally obtained one from another source and herewith present our findings.

Doubtless, most of our readers are familiar with the appearance of the National set from their ads. It is very modernistically styled, with dark green panel, lucite dial plate, and satin finished aluminum knobs and trim. We thought it quite handsome, though it might look a bit out of place in a period setting. Dimensions are 16-3/4"W x 7"H x 11½"D.

It features completely separate (operationally- they do share some tubes) AM and FM receivers, from antenna terminals to cathode follower outputs. Each section has its own volume control and tuning control, with the ON-OFF switch on the AM volume control. The AM section, in home listening tests, showed itself to be very sensitive and of good quality generally. An 18" antenna brought in a full complement of stations, both near and far. Unfortunately, it lacks a whistle filter and the 10 kc whistle was very much in evidence all over the dial. The AM tube lineup is: 6BA6 RF amplifier, 6BE6 mixer-oscillator, 2-6BA6 IF amplifiers, 6AV6 detector and AGC diodes, with the 6AV6 triode section as a squelch tube, and 1/2 12AX7 cathode follower output.

The FM tuner is somewhat less conventional - the front end, in common with many other high quality tuners, uses a 6BQ7 cascode RF amplifier, 6X8 pentode mixer and triode oscillator, and three 6BA6 IF amplifiers (the first two 6BA6's are shared with the AM tuner, with no evidence of objectionable cross-talk). The RF section is unusual in that it uses a 4 gang tuning condenser instead of the usual three. Both plate and grid circuits of the RF stage are tuned, as well as the antenna coil and oscillator. This aids in image rejection and preventing overload of the receiver by a strong local station.



The IF stages are also unusual - they employ special transformers with unusually high Q, designed essentially flat-topped response over a 200 kc bandwidth, falling off very steeply on the skirts. National has a reputation for manufacturing high quality IF and RF coils, tuning condensers, etc., and apparently has designed and made their own for the Criterion instead of buying them from the usual industry sources. The results show the success of this policy.

The limiters are 2-6BN6 dynamic limiters, featuring a very wide bandwidth. As we have stated earlier, this is important in quieting impulse noise.

The FM detector is quite unusual - National describes it as a "counter type detector". We don't know the details of its operation, but it is clearly neither a ratio detector nor a Foster-Seely discriminator. It is claimed to be linear over a band of several megacycles. As would be expected of a wide band detector, the audio output is low and a 12AX7 is used as a stage of gain and cathode follower output.

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As we stated earlier, separate AM and FM output connectors are provided for binaural operation. When the function selector is in the BINAURAL position, each tuner's output is connected to the appropriate jack. In either AM or FM position, the output of the selected tuner appears at another jack marked "tuner output". An FM multiplex output is provided, for connection to a multiplex adapter unit if this system of binaural transmission ever comes into use. This merely is connected to the FM detector ahead of the de-emphasis network. (Experimentally inclined readers living near a so-called"storecast" station will find this convenient for adding an external "commercial eliminator" and providing themselves with continuous background music minus commercials). A separate recording signal output, at an impedance of several thousand ohms, is fed from whatever tuner is being listened to, and from the FM channel in BINAURAL listening. It is designed to deliver approximately 1 volt output.

Other connectors are provided on the back of the chassis for tape playback output, preamp output, TV input and phono input. All of these are operative only when the plug-in preamp is inserted in the receiver. The tuner itself is supplied with a shorting plug in the preamp socket and a cover plate over the panel opening which receives the preamp. Our test receiver was equipped with a Horizon 5 preamp, which will be reported upon in a later issue. (Just as a preview, though, we'll say that it is a fine job in itself, with many unique and desireable properties. Outstanding among these, in our opinion, are the tone controls, which are the most versatile and best sounding we've ever heard). When the preamp is plugged in, it not only renders all these connectors usable, but its ON-OFF switch takes over from the one on the AM volume control, its dual loudness control is effective on both tuners simultaneously when listening binaurally, and its function selector switch turns off all power to the rest of the receiver except when in the RADIO position.

We have so far refrained from comment on the Criterion's most unusual feature - its dip-soldered printed wiring construction. It is constructed on several sub-chassis, with almost all the components on top of the chassis and only the printed wiring visible from below. This technique makes production of the sub-assemblies almost automatic, resulting in complete uniformity from set to set, plus greatly reduced manufacturing costs. A good part of the savings from the latter have apparently been passed on to the consumer, since the National line is better than competitively priced on all its items. We have seen it claimed that this type of construction facilitates servicing, but it looks like quite the reverse to us. Many components are almost inaccessible, between IF cans, etc. Unless one is familiar with techniques of working on printed wiring boards, great care must be taken to avoid damaging the unit while servicing it. Definitely no job for a hack serviceman!

Our laboratory tests showed that the Criterion came very close indeed to National's advertised performance claims. Sensitivity was 7 microvolts from 20 db signal/noise ratio, as compared to their 6 microvolt figure. Couldn't be much closer! We're not sure where their claim of "0.5 microvolt sensitivity when measured as most tuners are" comes from.

The IF bandwidth was exactly as indicated in their detailed service data -- 180 kc between -6 db points. At 50000 microvolts input signal this was only increased to 220 kc, indicating the effectiveness of the AGC action in preventing IF overloading.

Fig. 7 shows the noise quieting curve of the Criterion. At 7 microvolts, the audio output from a 30% modulated FM signal gives a 10 db increase over the background noise without a signal, in addition to 10 db of noise reduction - thus a 20 db S/N ratio. At 15 microvolts input, 30 db S/N ratio was obtained, with the ultimate 47 db S/N ratio occurring with signals of 100 microvolts or more (this includes almost every station audible in the N. Y. metropolitan area - some 20-odd stations).

No warm-up drift was detectable, and no measurable drift when measured at the detector output. This set is stable!

Listening to the National Criterion was a fascinating and most pleasurable experience. As we have mentioned, virtually every station which can be heard at all in this area produced full quieting action. The quieting was phenomenal, with absolutely no trace of ignition noise leaking through. We attribute this to the use of the 6BN6 gated beam limiters, since sets using only saturation limiters invariably have some ignition noise at our test location, even on the strongest signals. The velvety silence in the background added considerably to our listening pleasure. While we did not have the Scott 310 on hand, when we tested the National, it is our impression that it was approximately as effective in suppressing ignition noise. It, too, features a 6BN6 gated beam limiter stage.

The MUTAMATIC, or FM squelch circuit in the Criterion, is also most effective. Unlike the Scott, which squelches an audio stage, the National squelch voltage is applied to the limiter tubes. It is complete -- no hiss, hum, or other sound can be heard between the stations. On tuning in a station, the sound appears without any burst of noise - it's just there or not there, with no audible in-between state. A screwdriver adjustment on the chassis enables squelch sensitivity to be adjusted, but it is factory set at 15 microvolts. The MUTAMATIC feature can be switched in or out by a panel switch.

The National separated those two adjacent stations we mentioned in our discussion of the Scott 310, also giving a clean, definite dead space between them in the MUTAMATIC position. In another receiving location, it accomplished what we consider a near miracle, by picking up a third station between them! This intruder was located some 50 miles away and is not ordinarily heard in this area. Unquestionably, the steep-sided IF response of this set is a vital link in its superior performance.

Tuning was easy and non-critical, due to the flat-topped IF and wide band detector. All components ran at reasonably comfortable temperatures and workmanship was excellent throughout.

Summary and Comparison of Scott and National Tuners

Inevitably the question must arise of which of these tuners is "better" than the other. It should be obvious that no such categorical answer is possible, nor will be attempt to so rate them. Let us, however, compare them, feature by feature, and try to put the whole thing in a proper perspective:

1) Sensitivity. The Scott is about twice as sensitive as the National, which is about as good as any other tuner we have tested. However, either is more than good enough for 99.9% of the locations served by FM broadcasting. Unless DX is your dish, there really isn't too much to choose from on this score.

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2) Selectivity. Both sets feature extreme skirt selectivity plus a flat-topped IF response. We would say there is again no significant difference between them, but either is, in our opinion, superior to every other tuner we have seen.

3) Tuning ease: Both sets tune non-critically and precisely, with complete freedom from drift and no "rubbery" feel. However, the National dial scale is short and the calibration is next to useless for locating a desired station whose frequency is known. We more or less had to "fly blind" in tuning the FM band with this set. If only 3 or 4 FM stations are audible in your area, this won't matter. Here in New York we get 20-24 stations and it is far from easy to locate them on the National's dial. A logging scale would be a help. On the other hand, Scott's dial is unsurpassed in legibility and accuracy of calibration. We were repeatedly able to pre-set the dial to a desired channel and find the station perfectly tuned in when the set was turned on. Top place to Scott in this department.

4) Squelch effectiveness. The National "Muramatic" is definitely easier on the ears than the Scott "Dynaural", due to the absence of noise bursts when tuning in a station. Both are quite effective in their intended function, however.

5) Flexibility. Unquestionaly, the National is the most flexible tuner on the market. It is ingeniously integrated with their other units, so the user may incorporate a preamp if he wishes, or use it in the power amplifier. The BINAURAL feature is most convenient if your community is served with binaural broadcasts. If you require AM reception, probably the Scott is not for you. On the other hand, if you never listen to AM, the Scott offers top notch performance at a $20. saving over the cost of the National. Let it be said, though, that we have never seen so much extra performance and flexibility purchased for a $20. bill before!

6) Styling. This is up to you. Personally, the writer considers the National rather gaudy, and prefers the functional simplicity of the Scott - which is also about half the size of the National, by the way.

7) Relationship to the rest of the field. These two sets are cousins under the skin and we personally like either of them better than the ordinary, run-of-the-mill FM or FM-AM tuners on the market. Try one, if you get a chance, and see what you think.

JH

QUIETING VS SIGNAL TO NOISE RATIO

In the course of our FM receiver sensitivity measurements, we encountered a problem which caused us considerable confusion. FM receiver sensitivity is commonly expressed as "x microvolts for 20 db of quieting" (or 30 db, or 40 db, according to the individual manufacturer). We assumed that this meant measuring the RMS noise output of the receiver in the absence of signal and increasing the signal unitl the noise amplitude decreased by 20 db. We are not alone in that concept of quieting sensitivity, since several manufacturers definitely so specify the performance of their receivers.

In the course of correspondence with one manufacturer about one of his receivers, he pointed out to us that the IRE standard method of measuring FM receiver sensitivity called for the test signal

PILOTONE AA 903 Cont. from page 3.

for someone who wants a reasonably good, moderately priced amplifier and preamp combination. It's not quite as good as advertised in the categories of hum and power response, but well within specifications on just about all other points.

To balance the record a little, for $69.00, one could buy a Heathkit W4M Williamson amplifier and WA-P2 preamplifier, and after some 15-20 hours of work one would have a true Williamson amplifier whose I.M. distortion is about one-twentieth as much as the AA903 at 10 watts, and capable of putting out to full rated power over the entire audio spectrum (see Vol. 1. No.3 for the W4M report). The Heathkit preamp will not perform significantly better than the AA-903, 'though it is more flexible and some will find it more attractively styled.

Of course, many people would not care to assemble a kit, and for those the AA-903 represents about as good as can be gotten for the money.

As for the AA-903 being a better amplifier than the Fisher, Leak, Brociner, Scott and many othersamplifiers, this is patently ridiculous. We are sure that Pilot would not represent it as such. After all, it is rare enough, these days, to find a manufacturer who will turn out a good quality product at an attractive price and advertise it with reasonable restraint and objectivity. Pilot has done this, we feel, and CU's appraisal of the AA-903 comes under the heading of gilding the Lily.

By the way, the AA-903 sounds fine, too - in case anyone was wondering.

JH - GH

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QUIETING VS SIGNAL -----Con't

to be 30% modulated by an audio sine wave and the sensitivity to be expressed as the number of microvolts of signal which resulted in a 30 db reduction in output level when the modulation was switched off. This is certainly a more complete expression of sensitivity, but it seems to us a bit misleading to refer to it as a "quieting sensitivity." It is actually "x microvolts for 30 db signal to noise ratio."

At any rate, our signal generators are not equipped for frequency modulation so we obviously cannot employ this method directly. We do, however, approximate it quite closely as follows:

We measure noise quieting vs signal strength as originally described. At a value of signal input which produces 20 db of noise quieting, we vary the frequency over a 150 kc range, simulating 100% modulation. We read the change in DC output voltage from the detector corresponding to this frequency shift. This is the peak-to-peak audio output due to a 100% modulated signal. This value is then multiplied by the appropriate factors to convert it to the RMS voltage at the audio output terminals of the receiver corresponding to a 30% modulated signal. This value is "y" db above the noise output without a signal. It so happens that this increase in receiver output comes very rapidly with increasing signal strength, usually being almost at its final value well before full quieting is achieved. Therefore, "y + 20 db" equals, to a rather close approximation, the signal to noise ratio at "X" microvolts. Assuming "y" to be constant, we can add it to any portion of the quieting curve to find the signal-to-noise ratio at any value of signal voltage. Any errors introduced in this process favor the receiver, so we don't feel we are being unfair to any manufacturer. As a matter of interest, we have found that "y" equals 10-12 db for most FM receivers.

JH

WHAT IS NEW IN FM TUNERS Con't from page 1.

since the strong signal will creep in around the broad skirts of the IF response, so to speak, and the AFC will latch on to it instead of the weak one. Recently most sets have either provided an adjustable AFC action or one which can be disabled entirely.

Scott and National have taken a different approach to the tuning problem. First and foremost, both have wide band, flat-topped IF response curves (see Fig. 1b). Scott claims a 150 kc flat-top, National a 200 kc flat-top. Our approx. measurements confirm these figures. The skirts of the curve fall very steeply, so that adjacent channel interference is negligible. The flat top means that tuning is non-critical for optimum quieting, and that very little AM is introduced in the IF stages as compared to sets having the response of Fig. 1a.

Both Scott and National use wide band limiters and detectors. Scott claims that their unbalanced ratio detector and limiters are 2-megacycles wide, and National's detector and limiters have a 3-megacycle bandwidth. This tremendous bandwidth is desirable for good limiting on impulse noise and for a good capture ratio. A further benefit more immediately apparent to the user is the completely new tuning "feel" of such a set. The wide band detectors are effectively out of the picture as far as tuning is concerned. The response of the set is determined entirely by the IF response. No more triple response tuning, "rubbery" AFC, etc.! A station is heard, clearly and quietly, when it is anywhere in the IF/limiter pass band. The flat top makes tuning completely non-critical, and as long as oscillator drift is kept reasonably low (it is in both sets), it has no effect on the received signal - AFC is not needed.

Both sets feel quite similar in their tuning characteristics. The steep sided IF response means that nothing but the usual hiss is heard until one is tuned almost to the station. Then it suddenly appears, with full quieting, and the tuning dial can be advanced another 150-200 kc with no audible effect. Just as suddenly, the station disappears and noise reappears. In this respect, it is not too unlike a conventional set with AFC, with this important difference: Most sets, even with a small amount of AFC, "pull-in" over a range of several hundred kilocycles. These two sets are much sharper in their tuning, yet completely non-critical.

Both tuners also feature optional use of inter-station squelch, which "kills" the hiss between stations. Scott and National use completely different circuitry to accomplish their squelch action, with somewhat different results, so we will consider them separately.

At this point, we will depart from this general discussion of wide-band type tuners versus narrow band type tuners and consider these sets separately.

About Our Curves----

Our scotch tape assembly procedure on curves has backfired. Time being as short as it is, we have not re-done many which were prepared before we saw the proofs of the last issue.

A different process will be used in the future. We hope that this difficulty has not seriously inconvenienced you.

When you Write------

Please include the code on your stencil in all correspondence. It takes a lot of time to look up your name in our records if you fail to include this information. This time could be much better used to get the REPORTS back on schedule.

Coming Soon-----

We have scheduled for March what we believe is the most comprehensive test report on pickup cartridges ever released to the public. Response curves and listening appraisals will be presented on the ESL series, GE, Pickering, Fairchild, Audak, Sonotone and Weathers. We have had a few surprises ourselves in conducting these tests, and suspect our report will arouse a flood of controversy among our readers.

Radio Engineering Laboratories has loaned us a REL Precedent FM tuner which is now being tested. If space permits, this will be reported on in March, otherwise in April. We also plan to discuss some lower priced tuners, since we have so far been leaning rather heavily toward the more plushy jobs.

Welcome news to many should be the fact that we are preparing to test the Karlson 15" and 12" enclosures. We will try as many different speakers in these as we can.

The National Horizon 5 preamp will be reported on in the first issue that has space.

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